

## CRUDE OIL DEGRADATION BY MICROBIAL MATS

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Coastal cyanobacterial mats develop at the water-sediment interface in shallow environments such as estuaries, lagoons or sheltered sandy beaches where they stabilize the sediment. Evidence supporting the biodegradation capacity of these consortia for the elimination of crude oil residues is still limited. In addition to biodegradation, coastal spilled oil undergoes several physico-chemical alteration processes such as evaporation, water-washing or photo-oxidation.

These aspects are important for designing adequate remediation strategies of coastal oil spills such as that in the Arabian Gulf after the 1991 war. Intensive cyanobacterial growth on the oil top was observed soon after the spill (Sorkhoh et al., 1992). Crude oil was toxic for the cyanobacterial grazers but not for these photosynthetic organisms. This process was proposed to be a first step towards natural bioremediation (Radwan et al., 1999) but partial oil elimination was also attributed to the combined effects of physico-chemical weathering and microbial degradation (Sauer et al., 1998). Other reports indicated that cyanobacterial building mats in the Saudi coast led to preservation of oil residues (Barth et al., 2003).

The present work is addressed at gaining insight into the potential of microbial mats for crude oil degradation as compared to the physico-chemical processes. For this purpose analysis of samples collected in the Saudi Arabian Gulf coast after the 1991 oil spill in selected areas containing or devoid of microbial mats and development of microcosm experiments for exposure of microbial mats to oil pollution (Fig. 1).

The preliminary results arising from these experiments have shown that water weathering leads to more effective and rapid elimination of hydrocarbons amenable to washing and oxidation than microbial mat metabolism. Mat degradation occurs at a much lower rate than the weathering processes resulting in an apparent effect of preservation of low molecular weight aliphatic and aromatic hydrocarbons. This is not the case, however, for hydrocarbons containing nitrogen atoms (Garcia de Oteyza et al., 2006).

Microbial mats are also able to enhance elimination, at least in part, of long carbon chain hydrocarbons such as the C<sub>24</sub>-C<sub>30</sub> *n*-alkanes that are not very much affected by water weathering. Higher viscosity constitutes a limitation for the physico-chemical transformation of the oils through water weathering but not for biodegradation from microbial mats.

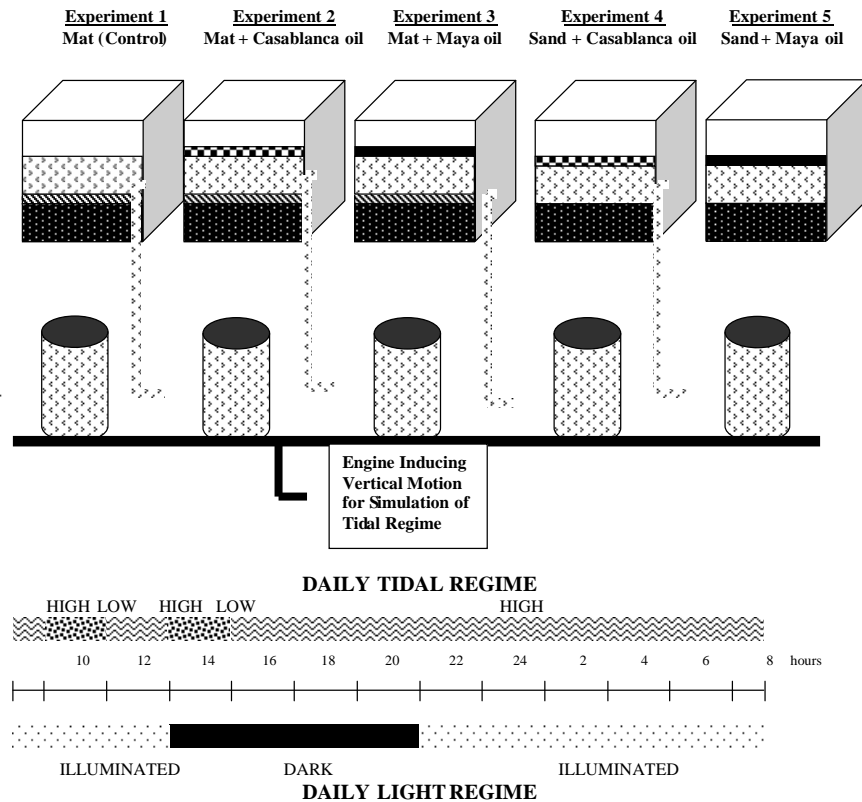


Figure 1. Experimental setups for the simulation of the oil degradation by microbial mats under tidal regime. 1: Development of the microbial mat without oil pollution: sand, microbial mat, water. 2: Degradation of Casablanca oil () with microbial mat. 3: Degradation of Maya oil () with microbial mat. 4: Transformation of Casablanca oil without microbial mat. 5: Transformation of Maya oil without microbial mat.

In the context of marine coastal oil spills, the results suggest that whereas the occurrence of microbial mats may delay the elimination of the most volatile crude oil fractions, higher degree of transformation of the less volatile oil constituents should be expected when these consortia of microorganisms are present.

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